INSTRUMENT DISPLAY VISUAL ANGLES FOR CONVENTIONAL AIRCRAFT AND THE MQ-9 GROUND CONTROL STATION

T. H. KAMINE[1], G. A. BENDRICK[2]

[1]University of Pennsylvania School of Medicine; [2]NASA Dryden Flight Research Center

Introduction: Aircraft instrument panels should be designed such that primary displays are in optimal viewing location to minimize pilot perception and response time. Human Factors engineers define three zones (i.e. “cones”) of visual location: 1) "Easy Eye Movement" (foveal vision); 2) "Maximum Eye Movement" (peripheral vision with saccades), and 3) "Head Movement” (head movement required). Instrument display visual angles were measured to determine how well conventional aircraft (T-34, T-38, F-15B, F-16XL, F/A-18A, U-2D, ER-2, King Air, G-III, B-52H, DC-10, B747-SCA) and the MQ-9 ground control station (GCS) complied with these standards, and how they compared with each other. Methods: Selected instrument parameters included: attitude, pitch, bank, power, airspeed, altitude, vertical speed, heading, turn rate, slip/skid, AOA, flight path, latitude, longitude, course, bearing, range and time. Vertical and horizontal visual angles for each component were measured from the pilot’s eye position in each system. Results: The vertical visual angles of displays in conventional aircraft lay within the cone of "Easy Eye Movement" for all but three of the parameters measured, and almost all of the horizontal visual angles fell within this range. All conventional vertical and horizontal visual angles lay within the cone of “Maximum Eye Movement”. However, most instrument vertical visual angles of the MQ-9 GCS lay outside the cone of “Easy Eye Movement”, though all were within the cone of “Maximum Eye Movement”. All the horizontal visual angles for the MQ-9 GCS were within the cone of "Easy Eye Movement". Discussion: Most instrument displays in conventional aircraft lay within the cone of “Easy Eye Movement”, though mission-critical instruments sometimes displaced less important instruments outside this area. Many of the MQ-9 GCS systems lay outside this area. Specific training for MQ-9 pilots may be needed to avoid increased response time and potential error during flight.

Learning Objectives: 1) Know three physiologic cones of eye/head movement; 2) Understand how instrument displays comply with these design principles in conventional aircraft and an uninhabited aerial vehicle system.

Question: Which of the following is NOT a recognized physiologic principle of instrument display design?

1) Cone of “Easy Eye Movement”
2) Cone of “Binocular Eye Movement”
3) Cone of “Maximum Eye Movement”
4) Cone of “Head Movement”
5) None of the above

Answer: # 2) Cone of “Binocular Eye Movement”